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ABBREVIATIONS AND SYMBOLS

- A - coefficient matrices in disaggregation process
- A - lower bound for 3 parameter log normal distribution
- A_k, A'_k - harmonic coefficients
- AR - autoregressive model
- AR(1) - lag one autoregressive model
- AR1BP - AR(1) with Beard's procedure
- AR1LT-2 - AR(1) with 2 parameter log normal distribution
- AR1LT-3 - AR(1) with 3 parameter log normal distribution
- AR1WHT - AR(1) with Kirby's modified W-H transformation
- ARMA - autoregressive moving average model
- ARMA(1,1) - autoregressive moving average model ($p=1, q=1$)
- ARMABP - ARMA(1,1) with Beard's procedure
- ARMALT-2 - ARMA(1,1) with 2 parameter log normal distribution
- ARMALT-3 - ARMA(1,1) with 3 parameter log normal distribution
- ARMAWHT - ARMA(1,1) with Kirby's modified W-H transformation
- a - time distance between the random number (η) in a simple broken line process
- $a_{i,j}$ - the i^{th} element of the residual series belonging to j^{th} month
- B - coefficient matrices in disaggregation process
- B - backward shift operator (i.e. $Bx_t = x_{t-1}$) ; also a parameter in ffGn or BL model
- B_k, B'_k - harmonic coefficients
- B^T - transpose of matrix B
- BL - broken line
- BL-H - BL with only high frequency term modified
- BL-HL - BL with both the high and low frequency terms modified
- b_j - least squares regression coefficient for estimating $(j+1)^{th}$ streamflow from j^{th} streamflow

- C - coefficient matrix ($= BB^T$)
 C_j - a sequence of random variables (zero mean and uncorrelation)
 $C_L(k;H)$ - covariance function of the low frequency term
 C_v - coefficient of variation ($=$ standard deviation/mean)
 C_s - coefficient of skewness
 FFGN-H - ffGn with only high frequency term modified
 FFGN-HL- ffGn with only high and low frequency terms modified
 FM - Methods of fragments using the annual flows from a Markov model
 FMM - Modified method of fragments using the annual flows from a Markov model
 FSC - First Spolia-Chander monthly model
 ffn - fast fraction noise
 ffGn - fast fraction Gaussian noise model
 $G(t)$ - gaussian random variable for the high frequency Markov term in ffGn model
 $G_m(t)$ - gaussian random variable for the m^{th} low frequency Markov term in ffGn model
 g - coefficient of skewness of the log values
 g_j - coefficient of skewness of the j^{th} monthly flow
 $g(C_j)$ - coefficient of skewness of C_j
 $g(t_j)$ - coefficient of skewness of t_j of the j^{th} monthly flows
 H - estimate of Hurst coefficient (h)
 Hist. - Historical values
 h - Hurst coefficient
 i - sequence number of generated data ; also year
 I - $(1 \times m)$ unit matrix
 j - repetitive annual cycles of seasons usually $1 < j < 12$; month
 K_1 - normalized variate
 k - lag ; random number uniformly distributed between $(0,1)$

in BL model

- L - number of low frequency Markov process of ffGn and number of simple BL processes
- MA - moving average
- N,n - sample size ; number of years of flow records
- P_p - autocorrelation matrix order p
- p - order of autoregressive process
- Q - parameter in ffGn generator
- Q_1 - annual flow volume in year i
- $Q_{1,j}$ - monthly flow for month j in year i
- $Q'_{1,j}$ - adjusted monthly flow volume for month j and year i
- Q_j - mean monthly flow for month j
- q - order of moving average process
- $q_{1,j}$ - standardized series of monthly flows
- $q'_{1,j}$ - monthly flow series after the removal of harmonic components in mean and standard deviation (fitted series)
- $q''_{1,j}$ - standardized fitted series
- q_j - mean of fitted series for month j
- R - multiple correlation coefficient ; adjusted range in chapter 5
- R/S - rescaled range
- r_j - serial correlation coefficient between streamflows in j^{th} and $(j+1)^{th}$ seasons
- r_m - lag one autocorrelation coefficient of the m^{th} AR process
- r_p - estimate of autocorrelation coefficient of lag p
- S_j - standard deviation of the j^{th} monthly flows
- SEN - Sen monthly model
- SSC - Second Spolia-Chander monthly model
- s - estimate of the standard deviation
- s_j - standard deviation of fitted series for month j
- S_{xx} - coefficient matrix in equation (6.3.4)

- S_{xy} - coefficient matrix in equation (6.3.3) and (6.3.4)
 S_{yx} - coefficient matrix in equation (6.3.4)
 S_{yy} - coefficient in equation (6.3.4)
 S_{zz} - coefficient matrix in equation (6.3.3)
 T - sample size in ffGn generator
 TF - Thomas-Fiering monthly model
 TT - Two-Tier model using the annual flows from Markov model
 TTM - Modified Two-Tier model using the annual flows from a Markov model
 t - time
 $t_{1,j}$ - random number having unit mean and zero variance
 u_k - the k^{th} element of the residual series
 V - matrix of random numbers
 V_m - weight attached to the m^{th} simple BL process
 $W-H$ - Wilson Hilferty
 $W_{1,j}$ - monthly flow for month j in year i having zero mean $= Q_{1,j} - \bar{Q}_j$
 W_m - weight attached to the m^{th} Markov process in ffGn generator
 $\bar{X}$ - estimate of mean annual flow
 X - matrix of monthly flow volumes
 $X_f(t;H)$ - ffGn variate
 $X_h(t)$ - high frequency Markov process (zero mean and unit variance)
 $X_L(t;H)$ - low frequency Markov term
 $X_L(t;r_m)$ - m^{th} low frequency Markov term
 X_t - annual flow in year t
 Y - annual flow volume
 Z - matrix of residuals (zero mean and uncorrelated) = BV
 Z_t - standardized flow in year t (zero mean and unit variance)
 α_j - parameters which reflect the relationships between successive months of the same year
 β_j - parameters which reflect the relationships between successive year for the same month

- Φ - parameter of the first order autoregressive process
 $\Phi(B)$ - autoregressive parameter
 Φ_p - p^{th} autoregressive parameter
 ϵ_t - random numbers with zero mean and unit variance
 η_m - random numbers with zero mean and unit variance
 ω - number of season (= 12 in this study)
 μ - population mean ; average monthly mean = $\frac{1}{12} \sum_{j=1}^{12} Q_j$
 μ_j - hamonic component in mean for month j
 ρ - lag one autocorrelation coefficient
 ρ_h - lag one autocorrelation coefficient of the high frequency Markov process
 ρ_j - lag one autocorrelation coefficient of j^{th} monthly flows
 $\rho_j(1)$ - lag one serial correlation
 $\rho_{j,j-1}(0)$ - lag zero cross - correlation coefficient
 $\rho_{j,j-1}(1)$ - lag one cross - correlation coefficient
 ρ_k - autocorrelation coefficient at lag k
 γ - coefficient of skewness
 γ_j - coefficient of skewness of j^{th} monthly flows
 γ_k, γ_{ze} - autocovariance in ARMA generator
 γ_x - coefficient of skewness of annual flow X_t
 $\gamma(X_f)$ - coefficient of skewness of the ffn variante
 $\gamma(X_h)$ - coefficient of skewness of the high frequency Markov term
 $\gamma(\epsilon)$ - coefficient of skewness of the random number used in the high frequency Markov process
 $\gamma(\epsilon_j)$ - coefficient of skewness of $\epsilon_{1,j}$ of j^{th} monthly flows
 $\gamma(\epsilon_m)$ - coefficient of skewness of the random number used in the m^{th} low frequency Markov process
 $\gamma(\xi)$ - coefficient of skewness of random variable ξ_t
 $\gamma(v_k)$ - coefficient of skewness of the k^{th} random variable in V
 θ - parameter of the first order moving average process
 $\theta(B)$ - moving average operator

- θ_q - q^{th} moving average parameter
 σ - population standard deviation ; average monthly standard deviation = $1/12 \sum S_j$
 σ_e - standard deviation of random variable e_t
 σ_j - hamonic component in standard deviation for month j
 σ_h^2 - variance of the high frequency Markov process
 σ_j - standard deviation of the j^{th} monthly flow
 σ_x - standard deviation of annual flow X_t
 ξ_t - random numbers with zero mean and unit variance